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PUBLIC WATER SUPPLIES IN ILLINOIS¹

BY G. C. HABERMEYER AND A. A. BRENSKY²

Public water supplies have been installed in more than 400 municipalities in Illinois. This includes about four in every five municipalities with more than 1000 population and one in every five with a population of less than 1000. The sources of supply and the number of municipalities securing water from each are as follows:

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In the northern part of the state, in many localities, water is available from several of these sources. Many cities located on the shore of Lake Michigan secure water from the lake. A large majority of all other municipal supplies are from wells in rock, as water of good quality is available from that source. In many places, waters from rock strata are preferable to waters from sand and gravel deposits on account of a lower content of iron.

In the central western part of the state, west of Illinois river, water is secured from Mississippi River by several cities located on its banks. A majority of all other supplies is from wells in rock. The water secured from wells in rock in this locality is much more highly mineralized than water secured from wells in the same strata in the northern part of the state. There are, however, few localities in this part of the state where an abundant supply can be secured from wells in drift and the cost generally to a small municipality of developing a well supply is less than the cost of impounding water from a stream and filtering the supply.

¹ Read before the Illinois Section, March 24, 1920. Discussion is requested and should be sent to the Editor.

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In the central eastern part of the state, east of Illinois River, is a large area in which nearly all municipal supplies are from wells in sand and gravel deposits. Nearly all wells in rock in this part of the state yield highly mineralized waters and many of the cities are located a considerable distance from any large stream or good impounding reservoir site. An abundant supply of water of good quality is not available in sand and gravel deposits throughout this part of the state and a few cities, Danville, Decatur, and Pontiac, secure water from streams. Kankakee and Streator, where water is secured from streams, may be considered to be near the northern limits of this area, and Carlinville, Pana and Charleston, where water is secured from streams, may be considered as near the southern limits of this area.

In the southern part of the state, south of Carlinville, nearly all supplies are from streams or impounding reservoirs. Several cities in the vicinity of East St. Louis and three or four other small cities in this area secure water from wells in drift. Throughout nearly all of this area, waters secured from wells in rock are very highly mineralized, though near the southern end of the state, in the vicinity of Cairo, some water of fair quality may be secured from wells in rock.

Wells in rock. In the northern part of the state, many cities secure water from wells in rock. The St. Peter and Potsdam formations, which outcrop in Wisconsin, yield more water than any of the other rock strata. In general, these strata dip to the south and east with a fold, with a steep western limb, extending northwest and southeast, passing near La Salle. To the east of this fold along the Illinois River, St. Peter sandstone is exposed.

Several wells into the St. Peter and Potsdam formations, located on low lands, have a natural flow. Near Mississippi River in the northern part of the state, several wells with an elevation at the top nearly 600 feet above sea level, yield as much as 250 gallons a minute each.

The best information available in regard to deep rock wells in the northwestern part of the state is of three wells which have been drilled into the Potsdam formation at Savanna. The first well was drilled in 1886 to a depth of 1432 feet and was 5 inches in diameter below a depth of 400 feet. The pressure at the ground surface was 30 pounds in 1890, 18 pounds in 1906 and 15 pounds in 1908. A second well was drilled in 1908 about 1700 feet distant from the first

well, to a depth of 1443 feet, and was 8 inches in diameter in the lower 1000 feet. It yielded 500 gallons a minute. The pressure at the ground with no flow was 14 pounds per square inch. In 1917 a third well was drilled 300 feet distant from the first well, on ground a few feet lower, to a depth of 1852 feet. This well is cased with 8-inch pipe to a depth of 880 feet, which is below the bottom of the St. Peter sandstone. The pressure at the ground surface outside of this casing (inside of a larger casing which extends 30 feet to rock) was $4\frac{1}{2}$ pounds and the pressure inside of the casing was 11 pounds. The yield, all from inside the 8-inch casing, was 312 gallons a minute. The yield of the first two wells drilled was given as more than one million gallons in 1908 and in 1916 it was about sufficient to supply demands of 700,000 gallons a day. In 1919 the three wells yielded about 960,000 gallons a day. Although this city is in the most favorable locality for flowing wells, the time is apparently approaching when, with continued lowering of the water level and decrease of yield of each well and increased consumption, it will be more economical to install pumps than to depend upon the natural flow of wells.

At Rockford three wells into the Potsdam formation and five into the St. Peter sandstone, connected by tunnel to a shaft, yield from 2,600,000 to 2,900,000 gallons a day. Two other wells, each pumped by an electrically-driven centrifugal pump, have been installed. One well is 22 inches in diameter at the top, 12 inches at the bottom and 1502 feet deep. It passes through the St. Peter sandstone and enters the Potsdam formation at a depth of 570 feet. When not pumping, water stands 16 feet below the ground surface. Pumping a half day at a rate of 2,250,000 gallons a day lowers the water level to 100 feet below the ground surface. The other well is of about the same dimensions and has about the same yield.

At Aurora water is secured from wells penetrating the St. Peter and Potsdam sandstones. These wells, except one on high ground, will flow if not pumped for some time. The Potsdam formation is entered at a depth of 1100 to 1200 feet. One well is 18 inches in diameter at the top, 15 inches in diameter at the bottom and 2262 feet deep. Equipped with a pump at a depth of 325 feet, it yields at times more than 1000 gallons a minute. After several hours pumping it yields 900 gallons a minute. Another similar well at Aurora has about the same yield.

Large quantities of water are secured from the St. Peter and Potsdam sandstones by industrial establishments and municipalities in the vicinity of Chicago. With continued and increasing demands the water level in this vicinity has been considerably lowered. Information in regard to supplies in this part of the state is contained in a bulletin soon to be issued by the State Geological Survey Division entitled "Artesian Waters in Northeastern Illinois." Information is also given in an article by C. B. Anderson in the 1914 *Proceedings* of the Illinois Water Supply Association.

Some water is secured in the northern part of the state from the Niagaran and Galena-Platteville limestones, which overlie the St. Peter sandstone and from limestone and sandstone which lie between the St. Peter and Potsdam formations. Several municipalities between Chicago and Kankakee secure water from wells 100 to 400 feet deep in the upper limestone strata.

At Galesburg, in the central western part of the state, a well has been drilled to a depth of 1252 feet, 10 inches in diameter at the bottom, and cased to the St. Peter sandstone. (The St. Peter sandstone is recorded in another well at a depth between 1000 and 1100 feet.) The static water level is at a depth of 183 feet. During a test the well yielded 540 gallons a minute with a lowering of the water level of 118 feet.

At Fairbury a well 8 inches in diameter at the bottom has been drilled to a depth of 2172 feet. St. Peter sandstone was recorded by the drillers between depths of 1350 and 1603 feet. Pumping 24 hours at a rate of 87 gallons a minute lowered the water level 91 feet to the pump cylinder at a depth of 300 feet.

Carbondale and Marion are the largest cities in the southern part of the state securing water from rock wells. At neither place is the supply entirely adequate.

At Mound City, in the southern end of the state, a well drilled to a depth of 630 feet in 1900 had a natural flow of 85,000 gallons a day. During pumping tests as much as 700,000 gallons a day has been secured.

Waters from rock in the central part of the state are more highly mineralized than waters from rock in the northern part of the state. A few supplies with the mineral content are listed on the next page:

CITY	DEPTH OF WELL	MINERAL CONTENT	PART OF STATE
	<i>feet</i>	<i>p.p.m</i>	
1. Savanna.....	1,440	300	Northwestern
2. Galesburg.....	2,414	1,060	Between 1 and 3
3. Mt. Sterling.....	2,235	4,400	Western
4. Aurora.....	2,250	415	Northern
5. Fairbury.....	2,000	1,300	*
6. Decatur.....	760	76,300	Central
7. Flora.....	900	61,000	South Central
8. Mound City.....	630	265	Southern

* At about southern limit of area in which water is secured from the St. Peter and Potsdam sandstones in the northeastern part of the state.

The mineral content depends partly upon the strata from which water is secured. In the northern part of the state where good water is obtained from the upper part of the Potsdam formation highly mineralized water is obtained at places at slightly increased depths.

The quality of water from a well is in places improved by casing part of the well to exclude oil, natural gas, hydrogen sulphide or water with other objectionable content. At Galesburg better water is secured from a well 2414 feet deep than from wells about 1300 feet deep. As in many similar cases, however, the water from the deeper well is rather highly mineralized.

Wells in drift. In the northern part of the state several small cities secure supplies from wells in drift, as the expense of a well is less than the expense of a well to the underlying rock, and abundant yields are secured in places. In nearly all localities in that part of the state, water secured from sand and gravel deposits contains more iron than does water secured from the underlying rock strata, accounting for a majority of cities securing water from the rock strata.

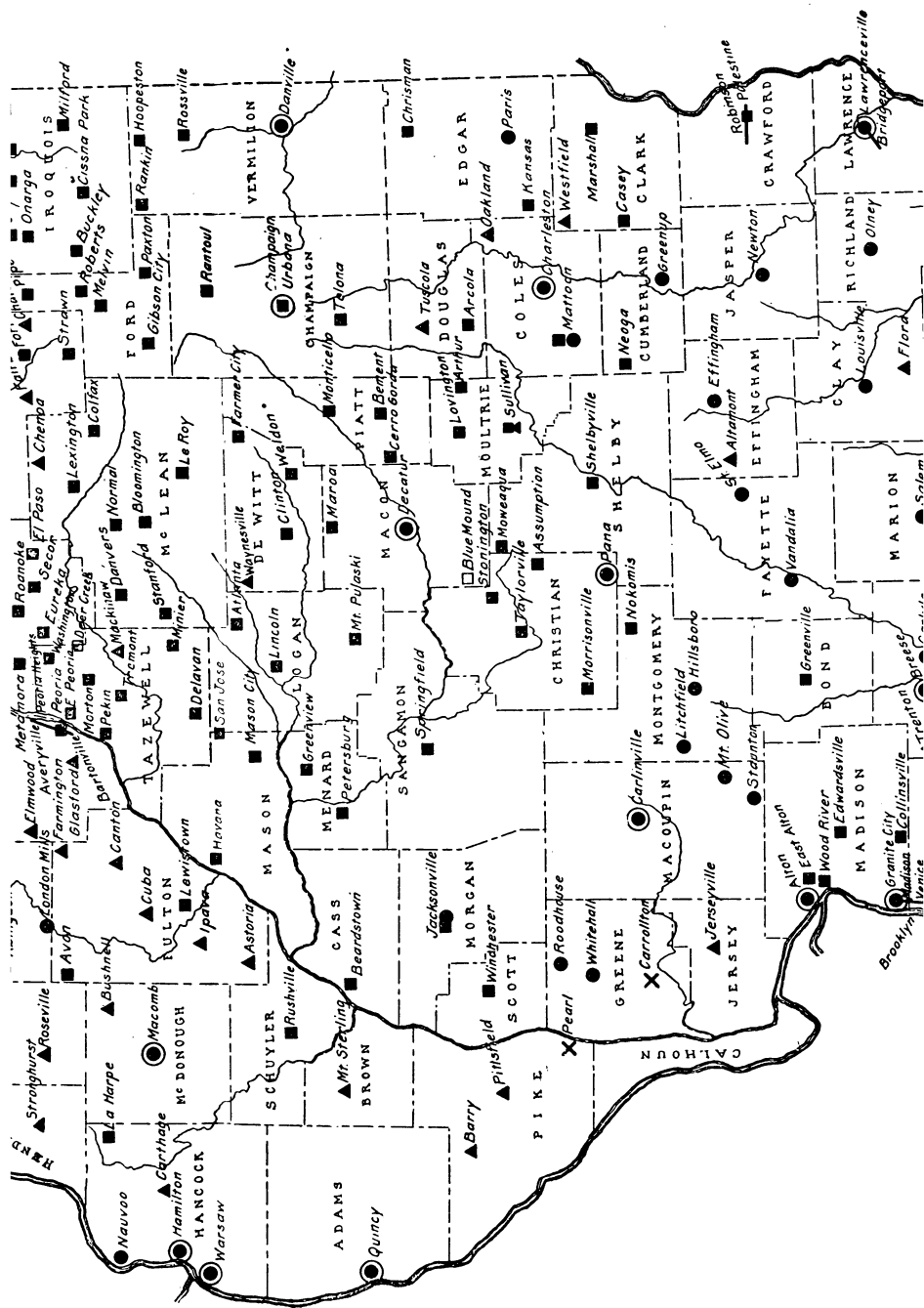
In the central eastern part of the state the largest cities securing water from sand and gravel deposits in glacial drift are Champaign-Urbana. The amount pumped for various supplies is probably about 3,000,000 gallons a day. In this part of the state wells 12 inches or less in diameter rarely yield as much as 200 gallons a minute. At Monticello a 12-inch well 209 feet deep in glacial drift yields more than 300 gallons a minute, with a lowering of the water level so small that it cannot be easily measured. At Bement, near

PUBLIC WATER SUPPLIES IN ILLINOIS

The map illustrates the distribution of public water supplies across Illinois. Key features include:

- Major Cities and Towns:** Chicago, Springfield, Peoria, Rockford, Decatur, Quincy, Alton, Hannibal, St. Louis, and many others.
- Water Supply Areas:** Indicated by dashed lines surrounding specific locations.
- Geographical Features:** Lake Michigan, Lake Erie, and the Gulf of Mexico.
- Neighboring States:** Indiana, Kentucky, Tennessee, Missouri, Wisconsin, Michigan, Minnesota, Iowa, and Arkansas.

The map is a detailed representation of the state's water infrastructure, showing the locations of public water supplies and the areas they serve.



Monticello, many wells have been sunk with a yield so small that the wells have been abandoned in favor of two original wells which yield about 30 gallons a minute each.

At Freeport in the northern part of the state and at Champaign-Urbana in the central eastern part of the state, plants have been installed to remove iron from water secured from sand and gravel deposits.

The largest cities securing water from sand and gravel deposits in valleys of streams are Peoria and Springfield. At Peoria a well 34 feet in diameter and 40 feet deep yields 4,000,000 to 5,000,000 gallons a day. In times of low water two wells 90 feet deep equipped with 7-foot diameter strainers are used. Each yields from 3,000,000 to 3,500,000 gallons a day.

In the vicinity of East St. Louis, some wells in bottom lands have a large yield. At Wood River the total yield of two 12-inch and ten 20-inch wells 110 feet deep is estimated at 25,000,000 gallons a day.

In the southern end of the state water is secured from wells in bottom lands of Ohio River at Metropolis and Brookport.

Surface water supplies. Surface water supplies are utilized by Chicago and other cities on the shore of Lake Michigan, by cities on the banks of Mississippi River, by a few cities located in the central part of the state and by nearly all cities in the southern part of the state which have public water supplies. Few data are available in regard to the yields of various water-sheds. The Department of Public Works and Buildings maintains gauging stations on several streams in the state. Records showing rainfall and runoff for a very short period of time, as published by the U. S. Geological Survey and by the State of Illinois Rivers and Lakes Commission, are given in figure 2.

When a supply is taken from a stream in which the flow is at times insufficient to supply demands, impounding reservoirs are constructed to store sufficient water to supply evaporation and excess of demands during time of low stream flow. The topography in parts of the state is flat and good sites are not available for reservoirs as evaporation is greater and objectionable growths are more plentiful in shallow reservoirs.

With the readjustment of incomes and prices now in progress, will come a demand for improvements in water works long deferred in the larger cities and for installation of water works in smaller

cities. Municipalities with not more than one hundred population, or less, where houses are not far distant and an adequate supply can be obtained, may with advantage install supplies similar to those installed in small municipalities, institutions and residences.

The State Water Survey Division collects facts and data concerning the water resources of the state in order to be of service to municipalities extending and installing water supplies.

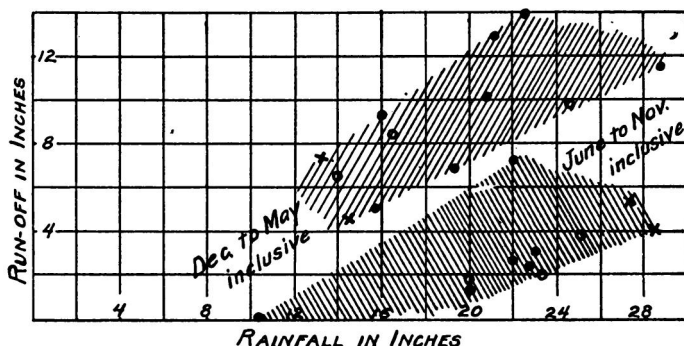


FIG. 2. STREAM FLOW IN SOUTHERN ILLINOIS

Data from Rivers and Lakes Commission 1914 Report and United States Geological Survey, Water Supply Papers.

● Stream flow in Big Muddy near Cambon and at Plumfield. Drainage area: 735 to 753 square miles. Rainfall: 1908, 1909 and 1910—average of Benton and Mt. Vernon; 1912—, Mr. Vernon; 1915, 1916 and 1917—, average of Ewing and Mt. Vernon.

○ Stream flow in Skillet Fork at Wayne City. Drainage area 481 square miles. Rainfall: 1909 and 1910—average of Flora and Mt. Vernon; 1911—Mt. Vernon.

× Stream flow in Shoal Creek near Breese. Rainfall at Greenville.

DISCUSSION

A. N. TALBOT: When the authors referred to the yield of wells in drift, they did not include the large new well of the University of Illinois, which has a discharge of 600 to 800 gallons per minute, a yield considerably greater than those mentioned.

EDWARD BARTOW: The authors spoke about the large amount of water obtained at Wood River. They did not say that that was at a refinery of the Standard Oil Company. Some of the members might not know why there was such a great demand. One of the largest oil refineries in the country is located at that point.